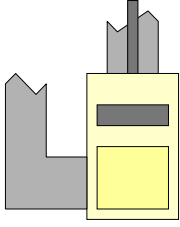






HVAC

Breathing (?)



- Capillary control
- Drying (air movement and diffusion)
- Fresh air

NOT random air leakage in buildings



Improving Indoor Air Quality

- Eliminate pollution sources
- Minimize unavoidable pollution sources
- Separate pollutants from occupants
- Ventilate:
 - Exhaust known pollutants at their source
 - Supply fresh (cleaner) air to dilute remaining pollutants



Air Exchange Ventilation

- Indoor air is exhausted from house
- Outdoor air is supplied to house
- Air exchange can occur
 - Naturally
 - Mechanically
 - Or a combination of both


Natural Air Exchange

- Unreliable, due to:
 - Dependency on outdoor conditions (temperature, wind)
 - Lack of occupant control (when, where, and how much)

Mechanical Air Exchange

- Reliable
- Occupant control of when, where, and how much
- Outdoor air can be treated as it enters the house (heat, cool, filter)
- Allows houses to be built tighter by providing fresh air and controlling moisture in winter





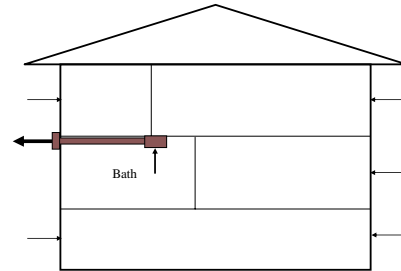
Air Exchange Strategies

- Exhaust fan only
- Supply fan only
- Exhaust and supply fans

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Central Exhaust Fan



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Quiet Bath Exhaust Fans



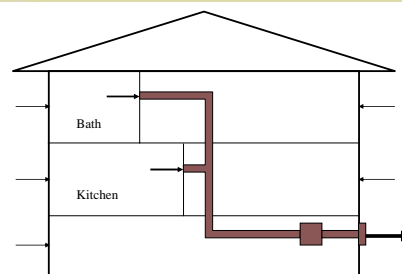
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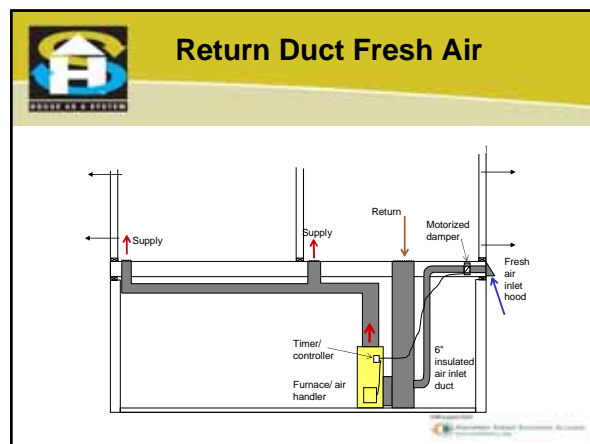
24-hour Timer Control



Remote Exhaust Fan

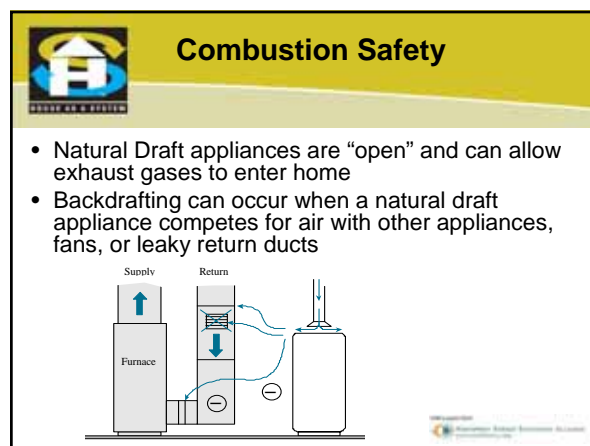
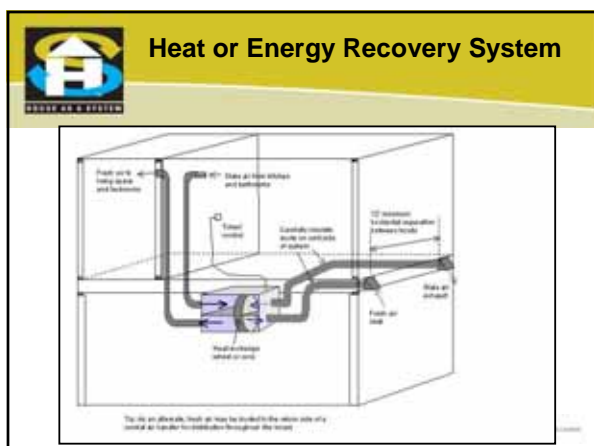


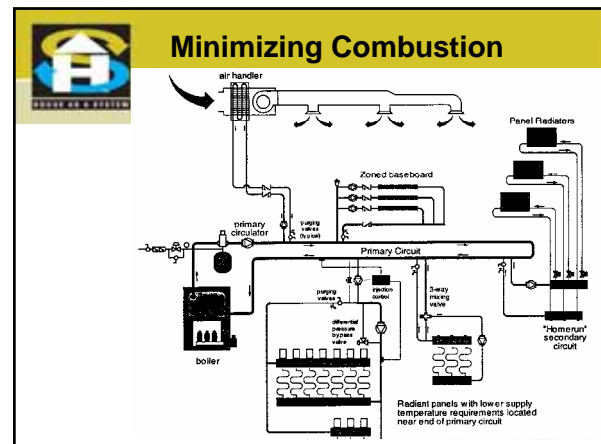
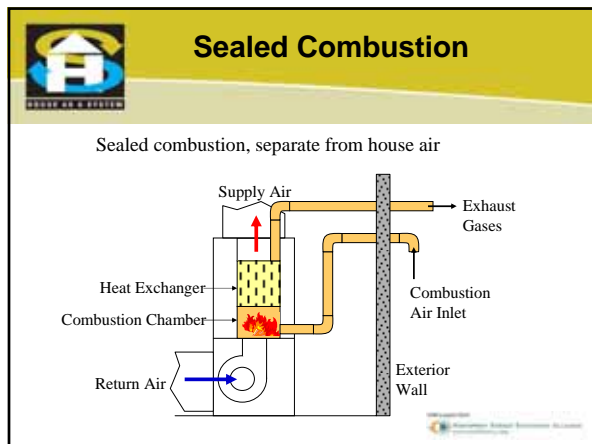
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Return Duct Fresh Air

- Needs proper control (www.fancycler.com)
 - Initiate vent-only fan cycles
- Needs motorized damper to limit vent cycles in peak conditions
- HVAC equipment must be correctly sized!
 - If oversized, large fan energy penalty





- ## System Sizing and Design
- Avoid "rule of thumb" sizing methods
 - Calculate room-by-room heat loss and heat gain using industry standard such as **Manual J**
 - Apportion distribution system according to heating and cooling loads of each room

- ## Quotes:
- "If an air conditioner runs for only five minutes instead of 10 minutes, you lose 1 point on the EER scale."
– John Proctor



System Sizing and Design

- Provide HVAC contractor with plans and specs that include:
 - R-value of exterior building components
 - Estimate of air leakage rate
 - Window and door schedule
 - Floor plans, elevations, cross sections
 - House orientation
 - Framing plans (for central air systems)

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HVAC in the Attic

- Disadvantages
 - Equipment & ducts in “outdoor” environment
 - Increase total heat loss and gain
 - Duct leaks cause air exchange between house and attic
 - Heating attic can lead to ice dams
 - Difficult to access and service equipment

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Bring the Ducts Inside

- Eliminate need to insulate / seal ducts
- Reduce length of duct runs
- 2x6 interior wall(s) to allow duct risers
 - Stack framing, floor registers
- Avoid attic ducts
 - Pay attention to sealing
 - Keep low to insulate over
- Avoid using stud/joist cavity as duct
 - ACCA says to avoid this technique



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Hydronic Issues

- Zone Control – differing loads, overheating
- Outdoor reset – proper settings, sensor location
- Overheating – rooftop boilers, cold start, proper sizing
- Condensing controls
- 2-pipe fan coils without dampers – no control

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HOUSE AS A SYSTEM Home Building Solutions Workshop

Duct Sealing



Ducts Inside

Why?

- Temperature
- Condensation
- Leakage



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Ducts Inside

Why?

- Temperature
- Condensation
- Leakage

How?

- Design
- Dropped ceilings
- Soffits
- Interior walls
- Unvented crawls
- Conditioned attics



Why Seal Duct Leaks?

- Reduce heating system efficiency
- Increase air leakage
 - 30-300% while blower is running
- Reduce comfort
 - drafts
 - unbalanced air delivery
- Promote combustion backdrafting

ENERGY STAR Requirements

- All duct connections outside thermal envelope must be sealed with mastic
- Duct tape or foil tape is not permitted
- Duct leakage must be measured by an approved Performance Tester

ENERGY STAR Requirements

Standard:

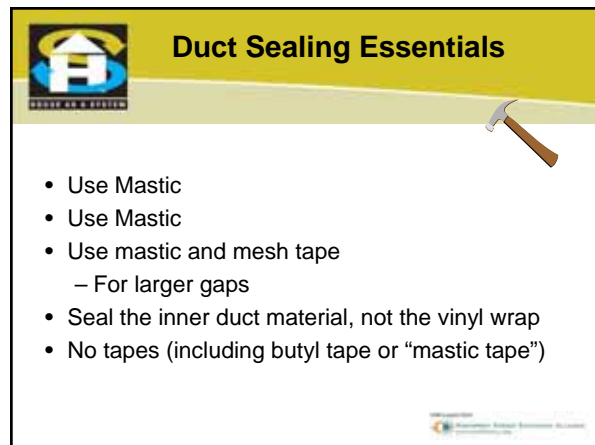
- Maximum total leakage of 6% of floor area (sq.ft.) at 50 Pascals
- Example: 2200 sq.ft. house
 $2200 \times 0.06 = 132 \text{ CFM}@50$

Worst duct leakage areas

- Swivel elbows
- Branch takeoffs from trunk ducts
- Other finger jointed connections
- Folded corners of boots and other fittings
- Filter racks, other plenum connections
- Sealing only the connections between duct sections will result in a leaky system!
- Missing pieces!









Energy Efficient Lighting

Requirement

- 50% of all sockets
- ENERGY STAR labeled



Informational
Communication
Education
Evaluation
Implementation
Maintenance



Energy Efficient Lighting

Requirement

- T-8 or T-5
- Electronic ballasts



Informational
Communication
Education
Evaluation
Implementation
Maintenance



Energy Efficient Lighting

Sequence for Success

Linear

- Garage
- Utility
- Under cabinet

CFL

- Ceiling "dish"
- Wall sconce
- Pendants
- Outdoor
- Recessed

Informational
Communication
Education
Evaluation
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Maintenance



HOUSE AS A SYSTEM Home Building Solutions Workshop

